

3. *Investigations in South African Fossil Reptiles and Amphibia* (Part 13).—By S. H. HAUGHTON, B.A., D.Sc., F.G.S., Hon. Curator, Palaeontological Collections.

13. Descriptive Catalogue of the Amphibia of the Karroo System.
(With 19 Text-figures.)

ORDER LABYRINTHODONTIA.

GRADE RACHITOMI.

“Labyrinthodonts with ossified basioccipital and basisphenoid Occipital condyle triple or double. Pterygoids usually with a medium-sized palatal part, interpterygoid vacuities of medium to large size. Pterygoids articulating with both parasphenoid and basisphenoid.

“Tabulars and dermosupra-occipitals with occipital flanges. Paroccipital always visible from behind.

“Vertebrae rachitinous, *i.e.* with small paired pleurocentra and half-moon-shaped intercentra.” (Watson.)

Fam. RHINESUCHIDAE, Watson.

1919. Watson, Phil. Trans., B. 209, p. 65.

“Rachitomi with somewhat depressed skulls, orbits small and far back, pterygoids not reaching the prevomers, interpterygoid vacuities of large size, no definite basipterygoid processes. Occipital condyle double. Clavicles expanded. Pubis ossified.” (Watson.)

Gen. RHINESUCHUS, Broom.

1908. Broom, Ann. S. Afr. Mus., vol. iv, pt. 7, p. 373.

1911. *Myriodon*, van Hoepen, Ann. Transv. Mus., vol. iii, pt. 2, p. 103.

1915. Haughton, Ann. S. Afr. Mus., vol. xii, pt. 3, p. 66.

1916. *Uranocentron*, van Hoepen, Ann. Transv. Mus., vol. v, pt. 4, p. 217.

1919. Watson, Phil. Trans., B. 209, p. 10.

“Medium-sized to large temnospondylous labyrinthodonts.

“Skull triangular, rounded in front, median length slightly greater than breadth. Eyes wholly in posterior half of skull. Otic notch present. Bones of skull-roof complete. Maxillary and dentary each carrying a row of uniform teeth, slightly decreasing in size posteriorly. Prevomere carrying one or more large tusks, a few medium-sized teeth, and covered (together with the major parts of the parasphenoid and the pterygoid) with minute denticles. Palatine with row of teeth similar to those on the maxilla. Small transpalatine with teeth present. Coronoid carries a number of denticles on upper surface.” (1915.)

Rhinesuchus whaitsi, Broom.

1908. Broom, *loc. cit.*, p. 373, pl. xlvi, fig. 3.

1915. Houghton, *loc. cit.*, p. 67, pl. xii, figs. 3, 4, text-fig. 7.

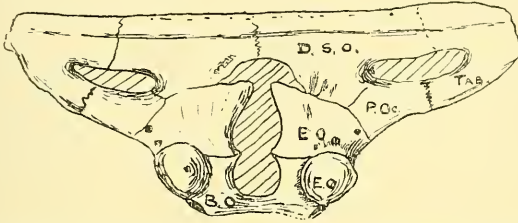
1919. Watson, *loc. cit.*, p. 11, fig. 3.

This is the type species of the genus, and was founded on a weathered basicranial portion of a skull found together with other fragmentary parts of the same skull. A complete skull from Beaufort West was described briefly in 1915; the only other specimen known to me is the posterior half of a skull from the *Tapinocephalus* beds of Blaauw Krantz, Prince Albert, C.P., which is encrusted with a thin layer of matrix that has so far resisted all attempts at removal.

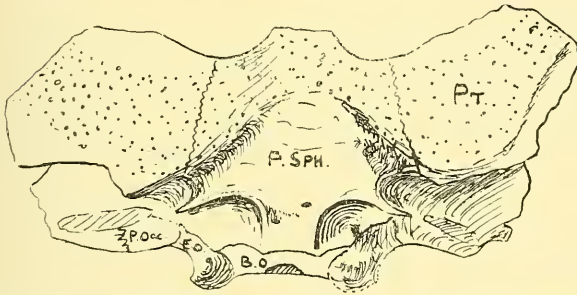
All these specimens are in the collection of the South African Museum, and have been re-examined in the light of Watson's paper; and examination of the two described specimens leads to the conclusion that the figure given by Watson, which is based on a drawing by Broom, requires certain emendations.

The type specimen (S.A.M., Cat. No. 1212) shows the following features: The basioccipital is large and forms the base of the foramen magnum, apparently completely separating the exoccipitals from one another; the posterolateral corners of the bone are overlain by the exoccipitals. The exoccipital condyle is fairly small. The exoccipital is a short, high bone reaching up to the dermosupra-occipital and having a flange on the upper side of the foramen magnum for the support of the cartilaginous supraoccipital. It is separated from the tabular by the paroccipital and from the pterygoid by a vertical wall of the parasphenoid which forms the lower border of the fenestra ovalis. The bone is perforated low down on its lateral face by the hypoglossal foramen. The epipterygoid has a powerful ascending process, but apparently no otic extension.

In the paratype (S.A.M., Cat. No. 3009) the sutures of the palate are extremely difficult to discern, but on the whole those given by Dr. Broom seem to be correct. It seems to me possible that, as mentioned in my original description, the prevomer passes down outside the palatal vacuity almost to meet the pterygoid—the whole of the mass of denticles in front of the vacuity then lying on the prevomer, and none on the palatine. This, however, is doubtful—but in *Eryops* the prevomer and pterygoid meet and exclude the



TEXT-FIG. 1.—Occiput of type of *Rhinesuchus whaitsi*, Broom.



TEXT-FIG. 2.—Palatal view of type of *Rhinesuchus whaitsi*, Broom.

palatine from the vacuity, and in *Rhinesuchus* it is to be expected that the structure would show but a slight advance on that.

The chief error in the figure given by Watson is in the omission of the anterior palatal vacuities. That these are present seems to me undoubted. They are somewhat small and may coalesce in the middle line for a short distance. In the figure, too, a row of teeth should be shown as lying along the whole of the border of the internal nares. In Watson's figure the basicranial region of the skull has been drawn from the type specimen and not from the complete skull.

Type.—Fragmentary skull. S.A.M., Cat. No. 1212.

Locality.—Near Fraserburg Road Station, Cape Province.

Horizon.—Lower Beaufort Beds (*Tapinocephalus* zone).

Distribution.—Lower Beaufort Beds; *Tapinocephalus* and *Endothiodon* zones.

Rhinesuchus senekalensis (van Hoepen).

1911. *Myriodon senekalensis*, van Hoepen, *loc. cit.*, p. 103, pls. i, ii.

1912. *Rhinesuchus major*, Broom, *Trans. Zool. Soc. S. Afr.*, vol. xiv, p. 79, pl. xiii, figs. 1, 2.

1915. Haughton, *loc. cit.*, p. 70, pl. xii, figs. 1, 2.

1919. Watson, *loc. cit.*, p. 52, fig. 29B.

The basicranial region of the skull in this species still remains unknown. In view of the palatal similarity between *Rhinesuchus* and the form described later as *Laccosaurus*, the generic position of the Senekal fossils must remain doubtful until the cranial structure is worked out. It is possible that the form will prove to be similar to that described as *Laccosaurus*; the geological horizon of the Senekal fossils makes that a feasible possibility. In that case van Hoepen's name *Uranocentrodon* has priority.

Type.—Portion of skull in Transvaal Museum, Pretoria.

Locality.—Senekal, Orange Free State.

Horizon.—Middle Beaufort Beds (*Lystrosaurus* zone).

The South African Museum possesses a portion of a skull and lower jaw from the type locality, from which no further details can be derived.

Rhinesuchus africanus (Lydekker).

1890. *Eryops africanus*, Lydekker, *Quart. Journ. Geol. Soc.*, vol. xlvi, p. 291, pl. xii, fig. 2.

1915. Haughton, *loc. cit.*, p. 76.

The specimen which I referred to this species in 1915 is certainly not a *Rhinesuchus*, as the basioccipital, if present, plays no part in the formation of the condyle.

The type of the species is a portion of a lower jaw. Little is known of the differences, if any, which exist between the mandibles of the related *Rhinesuchus*, *Laccosaurus*, and *Laccocephalus*; and in view of the fragmentary nature of the type this species will probably remain unidentified.

Type.—Mandibular ramus in British Museum.

Locality.—"Karoo."

Horizon.—Unknown.

Rhinesuchus capensis, sp. nov.

This species is founded on a skull in the South African Museum collection—Cat. No. 7419. The skull is large, resembling in general appearance the skull of *R. senekalensis*. Its chief dimensions are :

Greatest length	520–530 mm.
Length of top of skull in median line	450 „
Greatest breadth	360 „
Snout to front of nostril	25 „
Snout to front of orbit	270 „
Distance, orbit to nostril	210 „
Interorbital width	60 „
Greatest width across tabulars	160 „
Back of skull to pineal foramen	83 „

The skull is not in a good state of preservation. Sutures are almost impossible to determine—the skull seemingly being that of an aged animal in which all, or most of, the bones have become co-ossified. The general proportions can be seen from the figures on pp. 228, 229.

The skull is slightly narrower than that of *R. senekalensis* and considerably than that of *R. whaitsi*. The interorbital width is greater than in *senekalensis*. As far as can be seen, the dentition is that of a typical *Rhinesuchus*; the parasphenoid, pterygoids, and prevomers all carry numerous denticles.

In the basicranial region the skull shows an advance on *R. whaitsi* in that the basioccipital is almost wholly invisible in posterior view—the exoccipitals apparently meeting below the foramen magnum and above the posterior edge of the parasphenoid. The latter bone is typically that of a *Rhinesuchus*.

This form may be co-specific with *R. africanus*; but as the type possesses no lower jaw, the matter must remain in doubt.

Type.—Badly preserved skull, S.A.M., Cat. No. 7419.

Locality.—Spitzkop, Graaff Reinet, C.P.

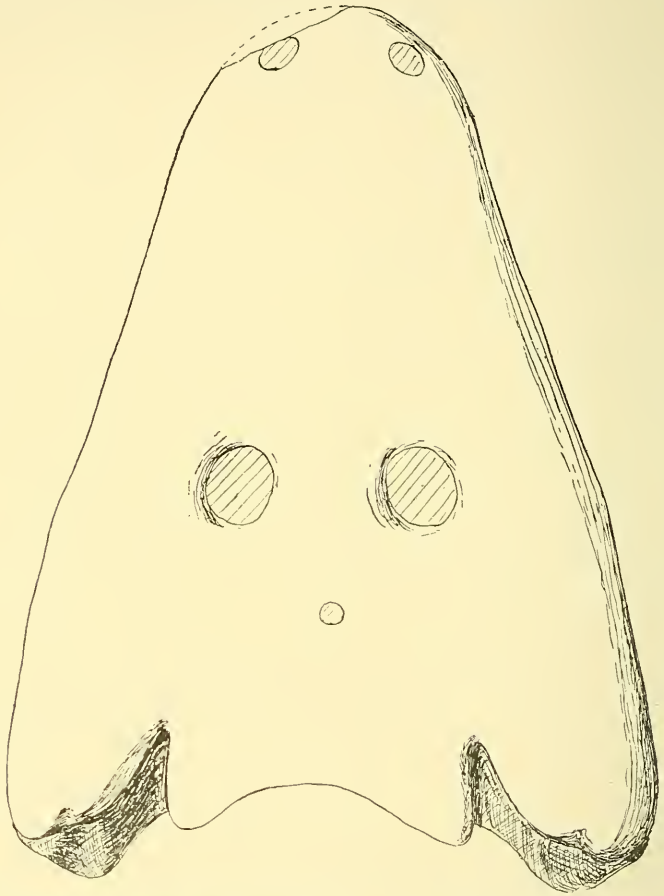
Horizon.—Lower Beaufort Beds (*Endothiodon* zone).

Gen. LACCOCEPHALUS, Watson.

1919. Watson, Phil. Trans., B, 209, p. 18.

Although placed by Watson in the Rachitomi, this form seems to approximate to the Stereospondyls in that “the exoccipital seems to articulate with the tabular very much as in *Capitosaurus*.” It does

not, however, reach forward to the pterygoid, so that the parasphenoid forms a very small part of the border of the bony fenestra vestibuli. It may be looked upon as an advanced member of the Rachitomi or an early form of the Stereospondyli. The basioccipital and basi-



TEXT-FIG. 3.—*Rhinesuchus capensis*, sp. nov. Dorsal view of type skull.

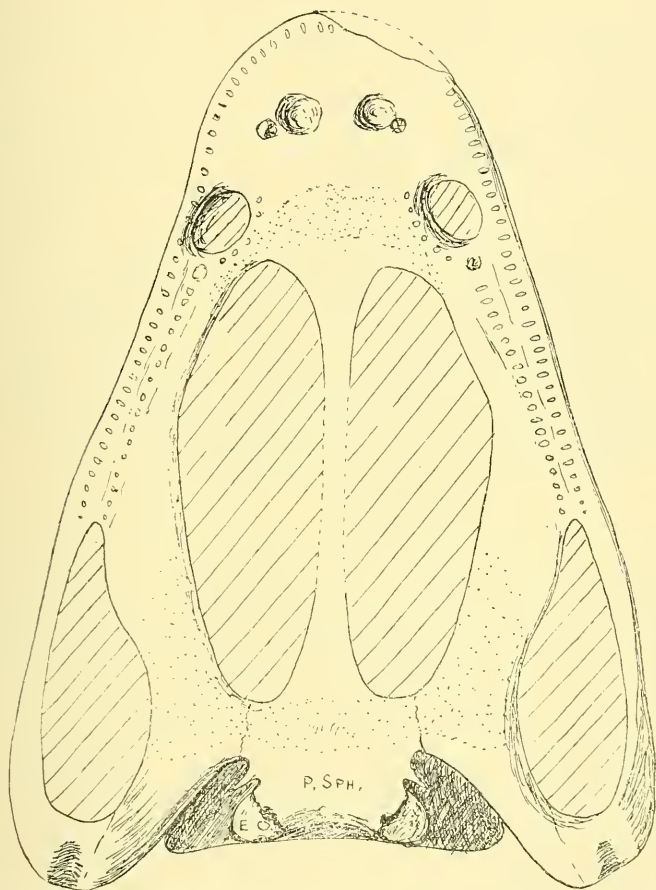
sphenoid are both ossified but not very large, and the latter seems to have no definite basipterygoid processes. The pro-otic is reduced; the epipterygoid is larger than in *Eryops*, but the otic process is still undeveloped. There are no small teeth on the palate.

Watson has shown (*loc. cit.*, p. 53) that the genus is intermediate between *Eryops* and *Capitosaurus*, and stands nearer the latter than does *Rhinesuchus*.

Laccocephalus insperatus, Watson.

1919. Watson, *loc. cit.*, p. 18, fig. 10, pl. ii, figs. 1, 2.

The only described species—known from an incomplete skull which



TEXT-FIG. 4.—*Rhinesuchus capensis*, sp. nov. Palatal view of type skull.

shows the sutures of the basicranium by means of fractures. Type specimen large.

Type.—Incomplete skull—British Museum, Cat. No. R 532.

Locality.—"Mr. Hope's Farm, Orange Free State."

Horizon.—Unknown.

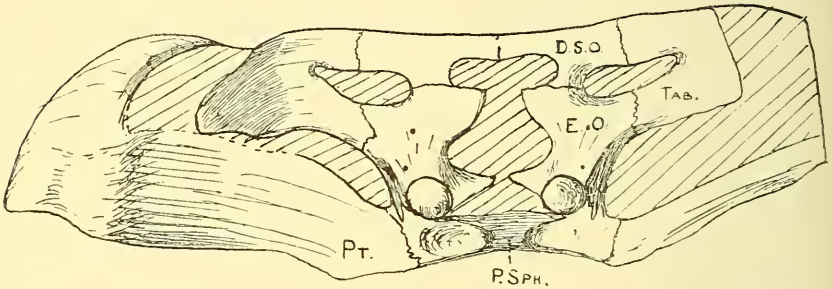
Gen. LACCOSAURUS, nov. gen.

Closely allied to *Laccocephalus*, but distinguished generically by the presence of small teeth or denticles on the palate as in *Rhinesuchus*.

Laccosaurus watsoni, sp. nov.

This species is founded on a single, beautifully preserved skull which lacks part of the antorbital portion, collected by the Rev. J. H. Whaits.

The median length was probably 230 mm., while the maximum width was 190 mm. The orbits lie in the posterior half of the skull, are small, and near the middle line; the nostrils are very far forward.



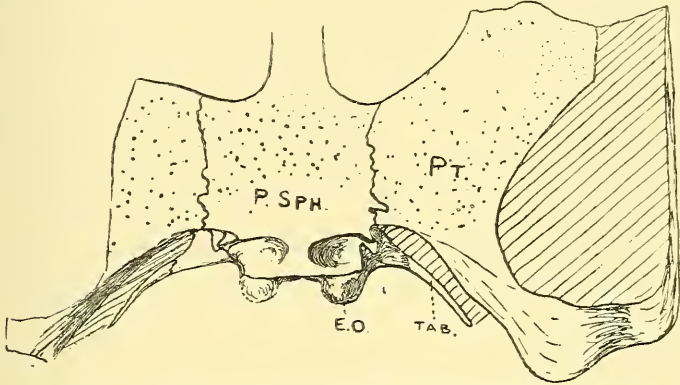
TEXT-FIG. 5.—Occipital view of type skull of *Laccosaurus watsoni*, gen. et sp. nov.

The chief features of the bones on the top of the skull are the large size of the nasals, the narrow frontals, the fact that the suprasquamosal forms part of the border of the otic notch and completely separates the squamosal from the tabular, and the fact that the tabular appears more on the occipital view than on the top surface of the skull. In general shape the skull is longer than that of *Rhinesuchus whaitsi*.

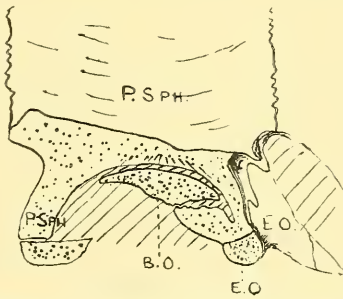
Parasphenoid.—The processus cultriformis is not displayed. The posterior part of the bone is as in *Rhinesuchus*, concave from side to side, articulating laterally with the pterygoids in interlocking sutures. The ventral surface of the bone is covered with denticles save for a bare portion posteriorly. Just mesial to the pterygoid suture the free posterior border has a little process similar to that of *Lydekkerina* and *Rhinesuchus* which supports a nearly vertical flange running up to the suture with the exoccipital. Mesial to this flange the parasphenoid is deeply excavate on each side of a median portion which gradually slopes upwards to a free posterior margin lying between and in advance of the exoccipital condyles. There is thus an approximation to the transverse ridge seen in *Capitosaurus*.

An irregular fracture shows the bone in its posterior half to have been broadly grooved. In the central channel lies the basioccipital, on either side of which the parasphenoid rises to meet the exoccipital.

Basioccipital.—This is a well-ossified zone, seen only in section. It plays no part in the formation of the double condyle. Its postero-



TEXT-FIG. 6.—Palatal view of back part of type skull of *Laccosaurus watsoni*, gen. et sp. nov.



TEXT-FIG. 7.—Irregular fracture across base of type skull of *Laccosaurus watsoni*, showing basioccipital resting on parasphenoid.

lateral corners are overlain by inwardly and forwardly directed processes of the exoccipitals as in *Laccocephalus insperatus*.

Exoccipital.—Seen from behind, the bone rises from the condyle as a pillar dividing superiorly into two parts. One forms the lateral border of the foramen magnum, has a strong mesial step, with a platform for the articulation of a cartilaginous supraoccipital, forming the inner border of the post-temporal vacuity. The other branch underlies the post-temporal vacuity and articulates with the tabular. The exoccipital has a powerful sutural union with the parasphenoid,

The papers by Broom and Watson have given an almost complete description of this species—Broom of the dorsal surface of the skull, Watson of the palatal and occipital aspects and of the post-cranial skeleton as far as it is known.

The South African Museum possesses one or two specimens, all from the *Lystrosaurus* zone of Harrismith, O.F.S. Specimen No. 3525 shows the dorsal view and part of the palate of the left half of a skull. The bones of the dorsal surface are arranged as in Broom's description. The lachrymal reaches the nostril in front but does not extend back to the orbit.

The processus cultriformis of the parasphenoid is narrower than in the figure given by Watson of "the palate of an average specimen." Our specimen, further, is smaller than the average. The anterior portion of the parasphenoidal plate and the adjoining portions of the pterygoids are furnished with numerous minute denticles.

The only other feature of note is in the occipital view. Here the sutures between the squamosal, quadrate, and pterygoid are slightly different from those in the British Museum specimen R 506, and in addition to the foramen on the suture between the quadratojugal and the quadrate, which is not actually seen in our specimen, the quadrate is pierced by two other foramina.

Type.—In British Museum.

Locality.—Near Edenburg, Orange Free State.

Horizon.—Middle Beaufort Beds. *Lystrosaurus* zone.

Fam. MICROPHOLIDAE, Watson.

1919. Watson, Phil. Trans., B, 209, p. 66.

"Small Rachitomi with a depressed skull. Large laterally placed orbits and otic notches. Interpterygoid vacuities very large. Definite basiptyergoid processes. Occipital condyle double. Clavicle not expanded." (Watson.)

Gen. MICROPHOLIS, Huxley.

1859. Huxley, Quart. Journ. Geol. Soc., vol. xv.

1913. Watson, Geol. Mag., N.S., Dec. v, vol. x, p. 340.

Characters as for family.

Micropholis stowi, Huxley.

1859. Huxley, *loc. cit.*

1876. *Petrophyne granulata*, Owen, Desc. Cat. Foss. Rept. S. Afr., p. 67, pl. xx, figs. 13-20.

1913. Watson, *loc. cit.*, p. 340, figs. 1-5.

1919. ,, Phil. Trans., B, 209, p. 20.

Watson considers this an advanced type, on account of the following features:—

1. The unique arrangement of the bones of the top of the skull—the frontal forms part of the orbital border, the lachrymal stretches from the nostril to the orbit, the jugal is very small, and the supra-temporal is much reduced, while the suprasquamosal is large.

2. The enormous interpterygoid vacuities.

3. The slender clavicles and great reduction of the cleithra.

4. The very slender humerus.

5. The loss of the grooves for the lateral line sense organs.

Type.—Incompletely preserved skull in British Museum.

Locality.—Rhenosterberg, Graaff Reinet, C.P.

Horizon.—Upper Beaufort Beds (*Procolophon* zone).

GRADE STEREOSPONDYLI.

“Labyrinthodonts with reduced basioccipital and basisphenoid. Occipital condyle double. Pterygoids with a reduced palatal ramus, interpterygoid vacuities large or very large. Pterygoids supported by the parasphenoid. Exoccipital meeting the occipital flange of the tabular so as to hide the paroccipital in occipital view.

Vertebrae stereospondylous, *i.e.* with very reduced or absent pleurocentra and large intercentra.” (Watson.)

Fam. CAPITOSAURIDAE, Watson.

1919. Watson, Phil. Trans., B, 209, p. 67.

“Stereospondyls, with elongated skulls with a comparatively broad snout. Orbits small, near the middle line and far back.” (Watson.)

Gen. CAPITOSAURUS, Munster.

1857. von Meyer, *Palaeontographica*, vol. vi, p. 221.

1908. Jaekel, *Lethaea Geognostica*, vol. ii, i, p. 13.

1912. Schroeder, *Jahr. d. Kon. Preuss. Geol. Landesanstalt*, vol. xxiii, p. 232.

1919. Watson, Phil. Trans., B, 209, p. 22.

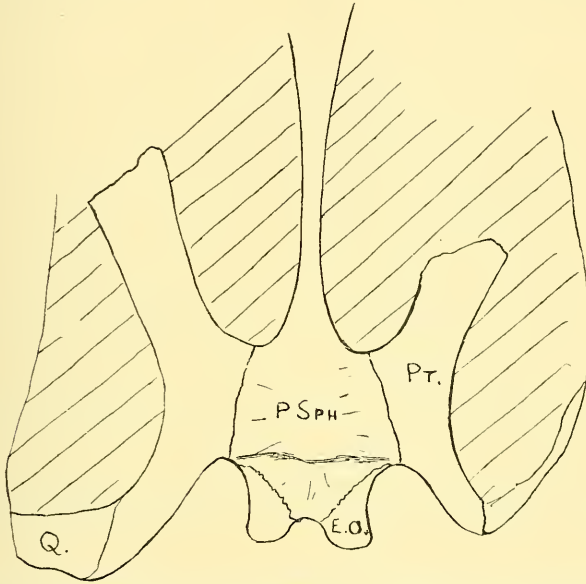
Skulls of medium to large size, with the otic notch open. Basisoccipital, basisphenoid, paroccipital and pro-otic all reduced. Epi-

pterygoid greatly expanded. Exoccipital just meeting the pterygoid. Quadrate only slightly behind level of condyles.

Capitosaurus africanus, Broom.

1909. Broom, *Ann. S. Afr. Mus.*, vol. vii, pt. 3, p. 271.

This species is founded upon an incomplete skull. The original description is very brief. There is in the collection of the South



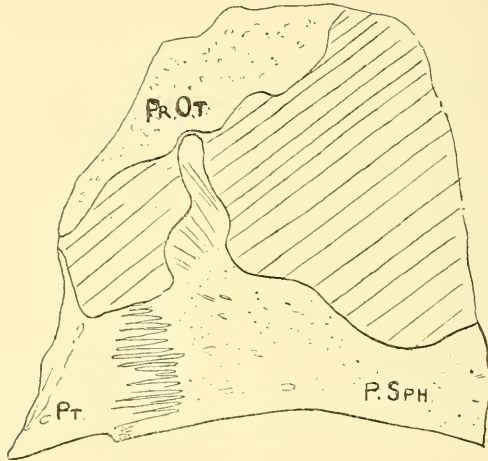
TEXT-FIG. 8.—*Capitosaurus africanus*, Broom. Palatal aspect of skull No. 3008.

African Museum (Cat. No. 3008) a skull collected by me at Winnaarsbaaken, Albert, C.P., which seems to belong to this species. The skull is complete save that the bones of the dorsal surface have almost entirely weathered away. The palatal surface of the posterior half has been developed, and the brain-case has been broken through in various directions in order to compare the structure with the account given by Watson of this genus.

That account, founded upon a skull to which he refers as *Capitosaurus* sp., is so full, that it is only necessary here to point out certain features which are worthy of note as being additional to, or different from, the description given by Watson.

Parasphenoid.—As in *Capitosaurus* sp., Watson, the parasphenoid ends in a free margin at the back of the skull below the condyles. In front of this the bone expands rapidly so that it forms a broad plate between the pterygoids. This plate is vaulted in the middle. The outer posterior corner of the bone just reaches the free edge of the skull. There is a slight ridge running across the lower surface of the bone at the level of the front of the exoccipital.

Basioccipital.—There is apparently no basioccipital preserved. The upper surface of the parasphenoid is concave, as in *Laccosaurus*; but



TEXT-FIG. 9.—*Capitosaurus africanus*, Broom. Section of skull No. 3008, showing relations of pterygoid, pro-otic, and parasphenoid.

the whole of the space between it and the top of the skull is, as far as the fractures show, filled with matrix. One longitudinal fracture shows the ragged anterior end of an exoccipital lying above the parasphenoid; a transverse fracture at the transverse ridge shows the parasphenoid with a lateral flange passing upwards to meet the pro-otic.

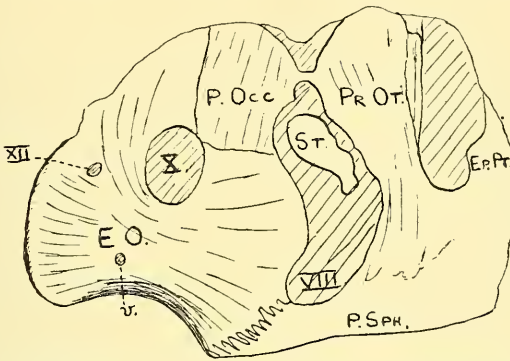
Exoccipital.—As in *Capitosaurus* sp., the bone forms the lower border of the bony fenestra ovalis. Seen from without, the body of the bone is perforated at the side by a large rounded foramen—the opening for the Xth nerve. Posterior to this is a much smaller opening, the exit for the XIIth nerve; and below these is a small venous foramen. The upper anterior portion of the bone, which meets the pro-otic above the fenestra ovalis, seems to be of somewhat different texture from the main mass and is probably paroccipital.

The exoccipital, pterygoid, and parasphenoid all meet at the lower border of the fenestra ovalis.

The sutures between the pterygoid, epipterygoid, and pro-otic are difficult of determination. The epipterygoid has a large anterior ascending plate, which is separated by a deep notch from the posterior otic process. This latter is indistinguishable in the specimen from the pro-otic, which forms the anterior border of the fenestra ovalis.

The stapes is seen in section lying in the fenestra ovalis. It seems to pass upwards and outwards.

The sphenethmoid is a low elongate bone lying above the anterior



TEXT-FIG. 10.—*Capitosaurus africanus*, Broom. Bones of right side of basicranial area and brain-case of skull No. 3008.

prolongation of the parasphenoid. It reaches upwards to the roof of the skull.

As far as can be ascertained this skull agrees closely with the description of *C. africanus*, Broom. Its chief point of difference from *C. sp.*, Watson, is the absence of a basioccipital and the probable absence of a basisphenoid. As Watson has shown, the loss of these bones gradually takes place with the advance of the Stereospondyls, and even in *Capitosaurus sp.* the basioccipital is very much reduced. In *Cyclotosaurus* both bones are absent; but this skull is less advanced than *Cyclotosaurus* in that there is no suture between the exoccipital and pterygoid to be seen in palatal view.

Type.—Fragmentary skull, S.A.M., Cat. No. 2360.

Locality.—Vaalbank, Albert, C.P.

Horizon.—Upper Beaufort Beds. *Cynognathus* zone.

Capitosaurus sp., Watson.

1919. Watson, Phil. Trans., B, 209, p. 22, figs. 11B, 12-16.

The skull designated thus by Watson is in the British Museum and was collected on the farm Watford, Albert, C.P., from the *Cynognathus* zone of the Upper Beaufort Beds. Watson has given a very full description of the bones of the brain-case, which has proved of very great value in linking together the various types of Stereospondyls.

Gen. *KESTROSAURUS*, gen. nov.*Kestrosaurus dreyeri*, sp. nov.

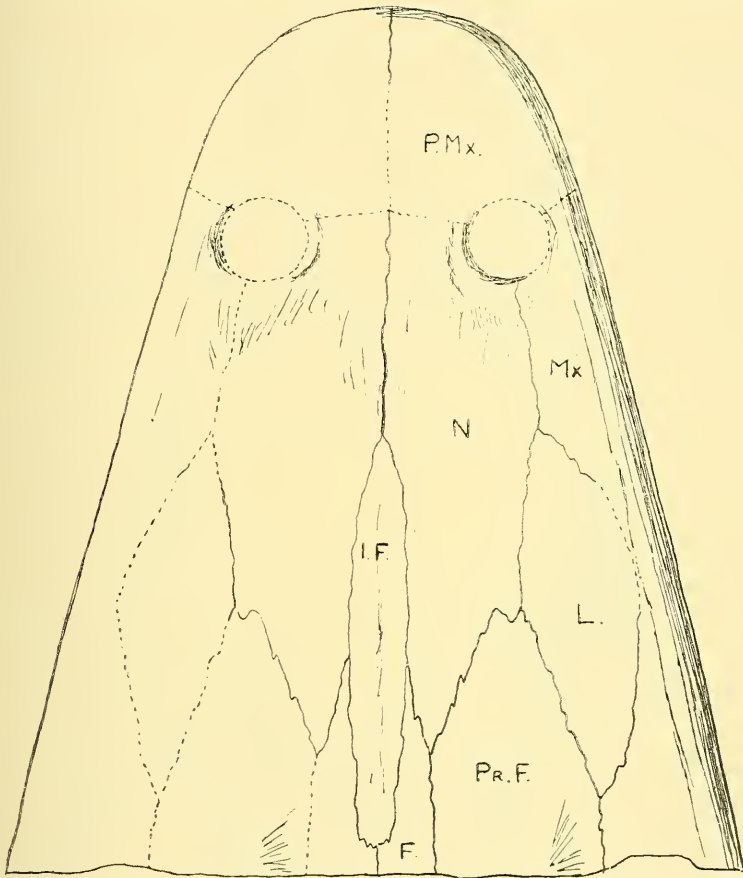
This new form is founded on a fairly complete large skull from the farm Harmonia, Senekal District, Orange Free State. It differs from the species of *Capitosaurus* in its greater elongation; but in the essential structure of the brain-region it agrees so closely with the generic features of *Capitosaurus* that it must undoubtedly be placed close to that genus in the family Capitosauridae.

The skull was found lying in a weathered condition, palate upwards, on a band of fine sandstone at the base of the Upper Beaufort Beds, not far above the horizon at Senekal which yielded *Rhinesuchus senekalensis*. The orbital portion was lost, but the anterior and posterior portions were collected; and, on the assumption that the outer line of the skull was regular, it has been possible to restore the outline. The fossil was first brought to our notice by Professor T. J. Dreyer, of Bloemfontein, in whose honour I have named the species.

The chief features of the dorsal surface of the snout are that the nostrils are small, rounded, and wholly on top of the snout, the large size of the nasals, and the presence of a narrow elongate interfrontal. A similar bone is seen in *Eryops* and in *Trematosuchus sobeyi*, and possibly occurs in other forms. Wiman (1916) considered that the bone was homologous with the Mesethmoid of Fishes; and Broili (1917) says that the inter-naso-frontal or naso-frontal, as he calls the bone, cannot be other than an ethmoidal. It should be noted in this connection that neither in this skull nor in that of *Trematosuchus sobeyi*, where the bone is also seen in cross-section, is there any irregularity in the ventral surface of the bone—no median ridge or channel appears, but the surface is quite smooth like that of the surrounding bones. Watson has given cogent reasons for refusing to accept those azygous elements as cartilage bones or ethmoid elements.

The orbits are not seen. The lachrymal does not touch either the orbits or the nostrils. The frontals are narrow.

The anterior palatal vacuities are separate, not coalesced. The palatine forms the posterior border of the internal naris. It carries

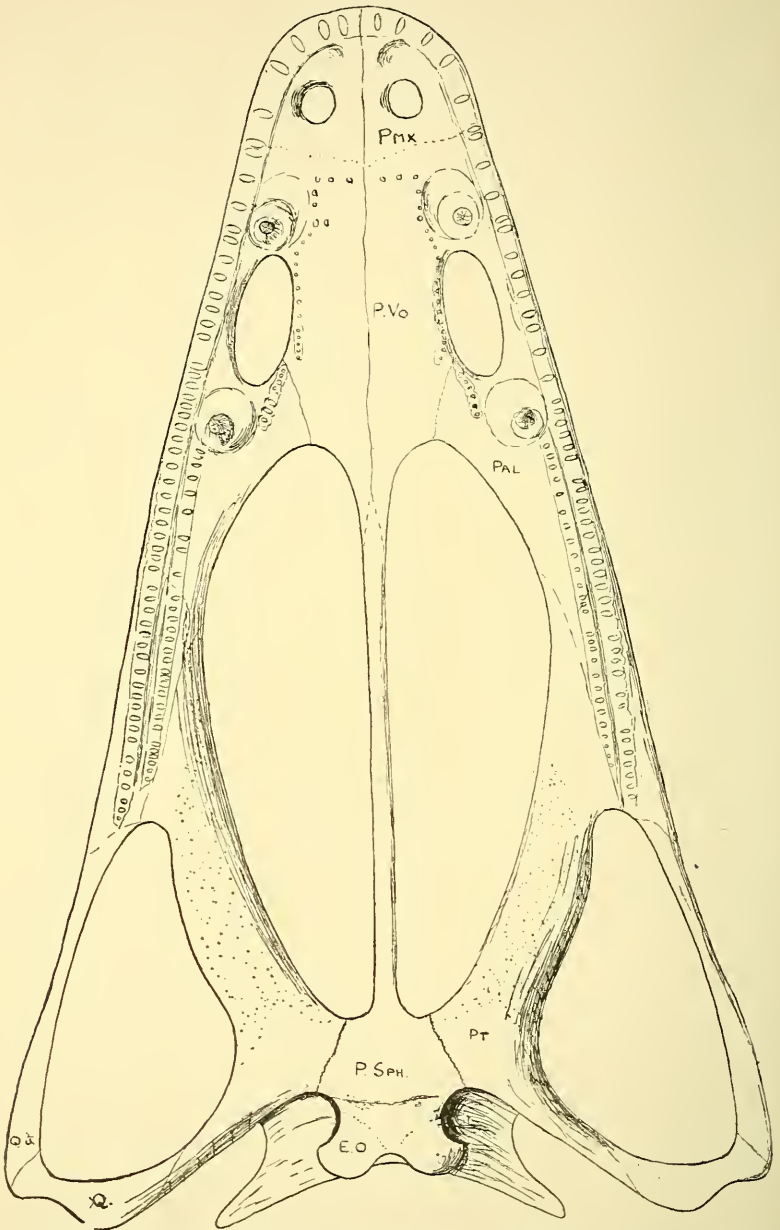


TEXT-FIG. 11.—*Kestrosaurus dreyeri*, gen. et sp. nov. Dorsal view of snout of type.

a large tusk behind the naris, a row of medium-sized teeth, similar to the maxillary teeth and parallel to them, and a short row of teeth mesial to the tusk.

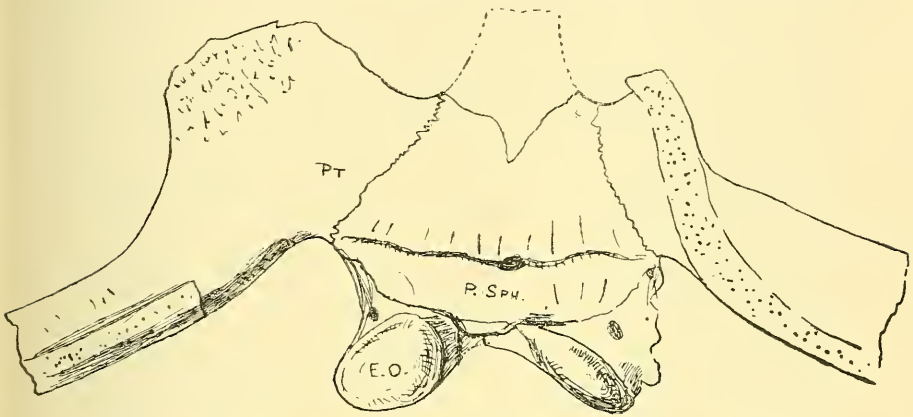
The prevomer carries a large tusk in front of the naris, a longitudinal row of teeth bordering the naris, and a transverse row between the tusks of opposite sides.

The anterior wing of the pterygoid is rugose.

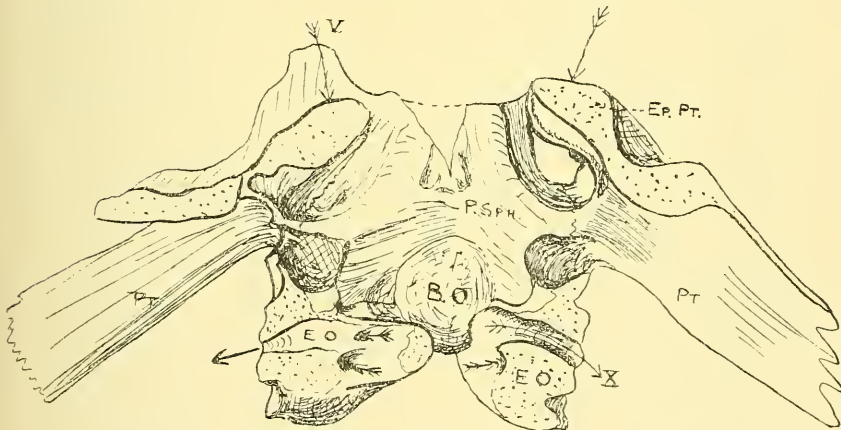


TEXT-FIG. 12.—*Kestrosaurus dreyeri*, gen. et sp. nov. Restoration of palate of type.

Parasphenoid.—The anterior stem of the parasphenoid is not well preserved, but it was undoubtedly long and narrow. The posterior portion of the bone is plate-like, widest posteriorly and articulates on



TEXT-FIG. 13.—*Kestrosaurus dreyeri*, gen. et sp. nov. Ventral view of bones of basicranium.



TEXT-FIG. 14.—*Kestrosaurus dreyeri*, gen. et sp. nov. Dorsal view of basicranium of type.

either side with the pterygoid by a deeply interlocking suture. The under surface is slightly hollowed out. Across the bone lies a prominent transverse ridge running between the ends of the pterygoidal sutures. Near the middle of this ridge two small nutritive foramina pass forward into the bone. The hinder end of the bone is free in

the middle and articulates with the exoccipitals in its outer thirds. The upper surface is well displayed. From behind the processus cultriformis two broad rounded ridges curve backwards, outwards, and upwards to form a slight protuberance above the front wall of the inner vestibule of the ear. Outside these ridges the bone slopes rapidly down to meet the pterygoid, so that on each side there is a curving, fairly deep and broad canal which opened forward by a large foramen for the exit of the branches of the Vth nerve. The outer posterior wall of this groove is formed by the pterygoid; and internal to this the parasphenoid must have articulated with the pro-otic, which is not preserved.

The parasphenoid forms the inner margin of the internal vestibule of the ear. Between these circular excavations the bone is deeply hollowed for the reception of the basioccipital.

Basioccipital.—This is a small, roughly circular ossification lying on the hollowed dorsal surface of the parasphenoid. It is thickest posteriorly and thins to a flange anteriorly. It is visible from behind, lying between the parasphenoid and the bridge of bone joining the exoccipitals which forms the floor of the foramen magnum.

Exoccipital.—The exoccipital condyle is convex, with a marked lateral and ventral ridged edge. In outer view, the bone passes forward to meet the pterygoid in a vertical suture, the bone forming the lower border of the fenestra ovalis. The suture with the parasphenoid is almost horizontal externally. Seen from above, the exoccipital forms the outer and most of the posterior walls of the vestibule, forming with the parasphenoid a comparatively thin wall of bone separating it from the deep recess in which the basioccipital lies. Traversing the vertical process of the bone which forms the side of the foramen magnum is the large passage for the Xth nerve, and a smaller tunnel for the hypoglossal nerve. Internally the wall of the brain-case is furnished with a small pit beneath the internal opening for nerve X.

The exoccipital meets its neighbour by a bridge of bone which lies above the basioccipital and forms the floor to the foramen magnum. The vertical process of the bone is divided into two wings, the outer meeting the tabular and the inner the dermosupra-occipital. The inner is not expanded as in *Capitosaurus* sp., Watson, and is shorter than in that form.

Paroccipital.—There is a small bone which lies on the exoccipital behind the passage for the Xth nerve and behind the fenestra ovalis. Its outer upper corner meets the tabular.

Basisphenoid.—It seems to be uncertain whether the basisphenoid is or is not completely ossified. Lying below the epipterygoid in the channel between that bone and the ridge on the dorsal surface of the parasphenoid is a rounded ossification which may be the basisphenoid. It is in contact with the lower inner surface of the epipterygoid.

Pterygoid.—This is similar to that of *Capitosaurus* sp., Watson.

Epipterygoid.—Only the basal portion of this bone is preserved. It lies on the outer edge of the anterior end of the quadrate ramus of the pterygoid, is thin laterally and thickens internally and above. Its posterior portion is thin, vertical, and concave from without; its anterior portion—when viewed from in front—is triangular in section as preserved, the outer face sloping inwards and upwards to give rise to the ascending process. The base of the triangle lies on the upper surface of the pterygoid and the outer edge of the parasphenoid, between it and the lower bones being a large foramen which lies externally to the lateral channel on the upper surface of the parasphenoid. This must be the foramen for the vena capitis lateralis.

Quadrate.—This has a large exposure on the posterior surface. The quadrate foramen is fairly small and low down, and lies on the suture between the quadrate and quadratojugal. The inner surface of the bone is overlapped by the pterygoid, which reaches back almost to the articular surface and which has a long articulation with the squamosal.

The complete absence of the paroccipital in the occipital view places this skull among the Stereospondyls. The relations with *Capitosaurus* sp. are seen to be as follows :—

1. The basioccipital is equally well ossified, and takes no part in the formation of the condyles.
2. The basisphenoid is less well ossified. Indeed, it may be doubtful if a bony basisphenoid be present, unless the cartilaginous bone mentioned as lying on the right of the dorsal surface of the parasphenoid be one of the paired ossifications seen in *Capitosaurus* sp.
3. The exoccipital articulates with the pterygoid and excludes the parasphenoid from the border of the fenestra ovalis; but the exoccipital-pterygoid suture is not visible in ventral view.
4. There is no ossified supraoccipital and, further, there is no step on the margin of the exoccipital, suggesting that the supra-occipital cartilage had disappeared.
5. The paroccipital is a very small bone; the pro-otic is not preserved—but the supports for it are comparatively thin walls of bone, so that it was probably reduced.

6. The ventral end of the epipterygoid is expanded and the bone must have had a large ascending process as well as an otic process.

In these features the form shows a slight advance on *Capitosaurus*, and it is also somewhat specialised in the elongation of the snout. It is probable, however, that its horizon is slightly lower than that of the skull described by Watson.

Type.—Incomplete skull, S.A.M., Cat. No. 3452.

Locality.—Harmonia, Senekal, Orange Free State.

Horizon.—Upper Beaufort Beds. Probably *Procolophon* zone.

Gen. CYCLOTOSAURUS, Fraas.

1889. Fraas, *Palaeontographica*, vol. xxxvi.

Similar to *Capitosaurus*, but the otic notch closed, and the exoccipital has a fairly long suture with the pterygoid.

Cyclotosaurus albertyni, Broom.

1904. Broom, *Rec. Albany Mus.*, vol. i, p. 178.

A large, imperfectly known species, founded on a very fragmentary skull.

Type.—Imperfect skull. S.A.M., Cat. No. 1876.

Locality.—Near Rouxville, Orange Free State.

Horizon.—Upper Beaufort Beds. *Cynognathus* zone.

Fam. RHYTIDOSTEIDAE, von Huene.

1920. von Huene, *Acta Zoologica*, p. 458.

Gen. RHYTIDOSTEUS, Owen.

1884. Owen, *Quart. Journ. Geol. Soc.*, vol. xl, p. 333.

Medium-sized skull with orbits placed laterally. Nostrils also lateral and far behind the point of snout. Basicranial region incompletely known; exoccipital has long suture with the pterygoid.

Rhytidosteus capensis, Owen.

1884. Owen, *loc. cit.*, p. 333, pls. xvi, xvii.

1919. Watson, *Phil. Trans.*, B, 209, p. 35, fig. 21.

1920. von Huene, *Acta Zoologica*, p. 458, fig. 14.

The type species. Characters as for genus.

Type.—Imperfect skull in the British Museum (No. 455).

Locality.—Beersheba, Orange Free State.

Horizon.—Upper Beaufort Beds. ? *Cynognathus* zone.

Fam. TREMATOSAURIDAE, Watson.

1919. Watson, Phil. Trans., B, 209, p. 67.

“Stereospondyls with relatively high skulls with narrow elongated snouts. Orbits of small or medium size, placed laterally. Processus cultriformis of the parasphenoid very narrow. Posterior end of the parasphenoid carried very far back and with the pterygoid forming a floor to the middle ear region.” (Watson.)

Gen. TREMATOSAURUS, Braun.

1849. Burmeister, Die Labyrinthodonten aus dem bunten Sandstein von Bernberg, Abth. i, p. 1.

Characters as for family.

Trematosaurus kannemeyeri, Broom.

1909. Broom, Ann. S. Afr. Mus., vol. vii, pt 3, p. 270.

1920. “? *Aphaneramma*,” von Huene, Acta Zoologica, p. 446, fig. 8.

The original description reads as follows :—

“The type of this new species is the centre part of a skull received from Dr. Kannemeyer and obtained by him in the Orange River Colony. Posteriorly it is broken obliquely across a little behind the orbits, and in front is broken through about 65 mm. in front of the orbits.

“The skull is evidently that of an animal about twice the size of *Trematosaurus brauni*, and it has probably differed from the type species in having the snout relatively longer.

“The orbit measures 31 mm. by 20 mm., and the interorbital measurement is 49 mm. At the back of the orbit the width of the skull is 94 mm., and at transverse plane 60 mm. ; in front of the orbit 64 mm. .

“The surface of few of the bones is preserved, but where it is found it is seen to be pitted as in *T. brauni*, and a groove runs up the snout and passes along nearer to the middle line than to the orbit.

“The frontal does not enter the orbital margin, and passes much further forward than in *T. brauni*, the anterior end being in advance of the portion preserved.

“ The prefrontal is large, and ends about 55 mm. in front of the orbit.

“ The postfrontal is long and narrow, and, so far as preserved, fairly similar to that figured by Burmeister in *T. brauni*.

“ The postorbital is peculiar. It forms 9 mm. of the orbital margin, but behind the orbit it becomes rapidly constricted till it measures only 4 mm. across, and then slowly widens out till it measures 13 mm. The preserved portion measures 43 mm. in length, and probably at least 10 mm. are missing.

“ The maxillary teeth are not well preserved. Where preserved they are small and uniform, and eight occupy 11 mm.

“ The parasphenoid (vomer) is very narrow.

“ The resemblance of this South African form to *Trematosaurus brauni* are sufficiently great to leave little doubt that both should be placed in the same genus. The Spitzbergen Labyrinthodont recently described by Smith Woodward as *Aphaneramma rostratum* has an elongated snout, but is not allied to the South African form.”

Von Huene considers, however, that the two forms are closely allied.

Type.—Middle portion of skull (S.A.M., Cat. No. 1329).

Locality.—Orange Free State.

Horizon.—? Upper Beaufort Beds.

Gen. TREMATOSUCHUS, Watson.

1919. Watson, Phil. Trans., B, 209, p. 41.

Trematosuchus sobeyi (Haughton).

1915. *Trematosaurus sobeyi*, Haughton, Ann. S. Afr. Mus., vol. xii, pt. 2, p. 47, fig. 6, pls. viii, ix.

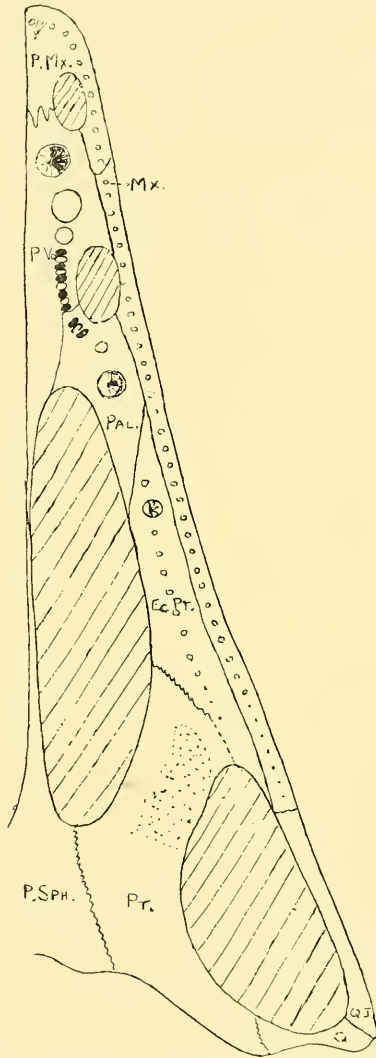
1919. Watson, *loc. cit.*, p. 41.

1920. *Trematosaurus sobeyi*, von Huene, Acta Zoologica, p. 443.

The type of this species was described in 1915. Watson says: “ *T. sobeyi* does not belong to *Trematosaurus*, differing in having no anterior palatal vacuities between the premaxilla and prevomers, in lacking the corresponding perforations of the dorsal surface of the premaxillae and in the distribution of the palatine and ectopterygoid teeth.”

Re-examination and further development of the extreme front of the palate show that the original description was incomplete and therefore misleading. The South African form possesses an anterior

palatal vacuity placed exactly as in *Trematosaurus brauni*, i.e. bounded on the outside and in front by the premaxilla and behind



TEXT-FIG. 15.—*Trematosuchus sobeyi* (Htn.). Left side of palate of type.

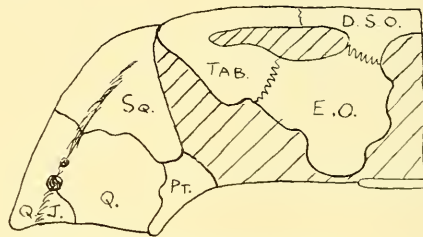
by the prevomer. Reference to the photograph published with the original description will show that the premaxillae are very thin in their dorsal portions, the bone on the left side having been lost in

front of the nostril. While the bone is not actually perforated when perfect, its under surface is concave and the bone very thin.

It is probable that the suture between the pterygoid and ectopterygoid is as in *T. brauni*, and not as originally figured by me.

The distribution of the palatal teeth differs very slightly in the two forms, while in *Trematosuchus* the palatine is smaller in relation to the ectopterygoid than in *Trematosaurus*, the suture between the bones being longitudinal in the South African form, and not transverse. In this connection, however, it should be noted that the suture in Watson's figure of *T. brauni* is dotted, being apparently a doubtful one.

The occiput as far as it is preserved agrees with that of *T. brauni*. The condyles are broken off, but they were obviously paired. The



TEXT-FIG. 16.—*Trematosuchus sobeyi* (Htn.). Left side of occipital aspect of type.

quadrate, however, is a larger bone in the South African form, and the posterior portion of the squamosal correspondingly smaller.

While accepting Watson's change in nomenclature, it should be noted that most of the reasons advanced by him fall away, and that the differences between the two genera are very small. In nearly all essential details the two forms agree closely, and there can be no doubt that the two are closely allied. The South African form is, of course, considerably larger than *Trematosaurus*.

A portion of a small skull from the type locality (S.A.M., Cat. No. 5136) is probably part of a small member of the species. It is an incomplete postorbital section, which shows among other things the right quadrate region. Here the quadrate is seen to pass up a considerable distance in front of the occipital part of the squamosal, the latter covering most of the quadrate in occipital view. The inner edge of the quadrate articulates with the pterygoid. An interesting feature is that in this apparently immature specimen neither the ectopterygoid nor the adjacent part of the maxilla carry teeth. The anterior ramus of the pterygoid is faintly rugose in its middle part.

The bones of the surface of the skull, as far as they are preserved, agree with those of the type; the suture between the parietals is open; those between the other bones much more closed. The frontals had dropped out before fossilisation.

Type.—Skull (S.A.M., Cat. No. 2779).

Locality.—Sobey's Quarries, Queenstown, C.P.

Horizon.—Upper Beaufort Beds. *Cynognathus* zone.

Gen. MICROPOSAURUS, gen. nov.

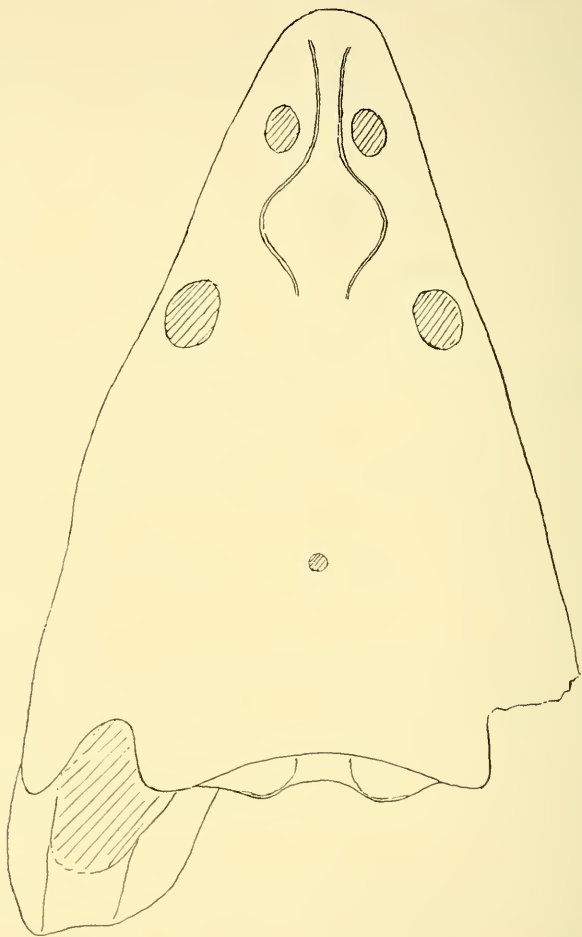
Microposaurus casei, sp. nov.

The skull which forms the type of this genus and species was discovered by Dr. E. C. Case and the writer in 1923 during an examination of the exposures just above the Wonderboom Bridge, south of Burghersdorp, and is thus from the *Cynognathus* zone. The skull was embedded palate upwards, in a fairly soft dark-green shaly mudstone. The bone, however, is coated with a thin layer of very hard ferruginous material—almost pure hematite—which it has been found impossible to separate from the rugose upper surface of the skull. Consequently it has not proved possible to trace sutures, and the following description is therefore very incomplete. Nevertheless, the general features of the skull are sufficiently distinct to justify one in naming it.

The skull is triangular in shape, longer than broad, with straight sides. The snout is rounded. The nostrils are not terminal, not lateral, and fairly close together. The orbits are small, lateral, and wholly in the anterior half of the skull. The otic notches are small. The quadrate is considerably posterior to the occipital condyles, although this feature may have been accentuated by post-mortem crushing.

The premaxillary and maxillary teeth are of more or less uniform size, the two anterior being larger than the others. The palate carries several large tusks. On the right-hand side two tusks occur in front of the internal naris; on the left the hinder of the two alone is preserved. Internal to each choanal opening is a bowed ridge carrying a number of fairly small teeth. On the left-hand side two large tusks are carried by the palatine, behind the internal naris; on the right only one tusk is present. What is presumably the ectopterygoid bears a row of teeth which decrease in size posteriorly. The anterior lateral wings of the pterygoids carry a number of denticles; but neither the prevomer nor the parasphenoid seem to do so.

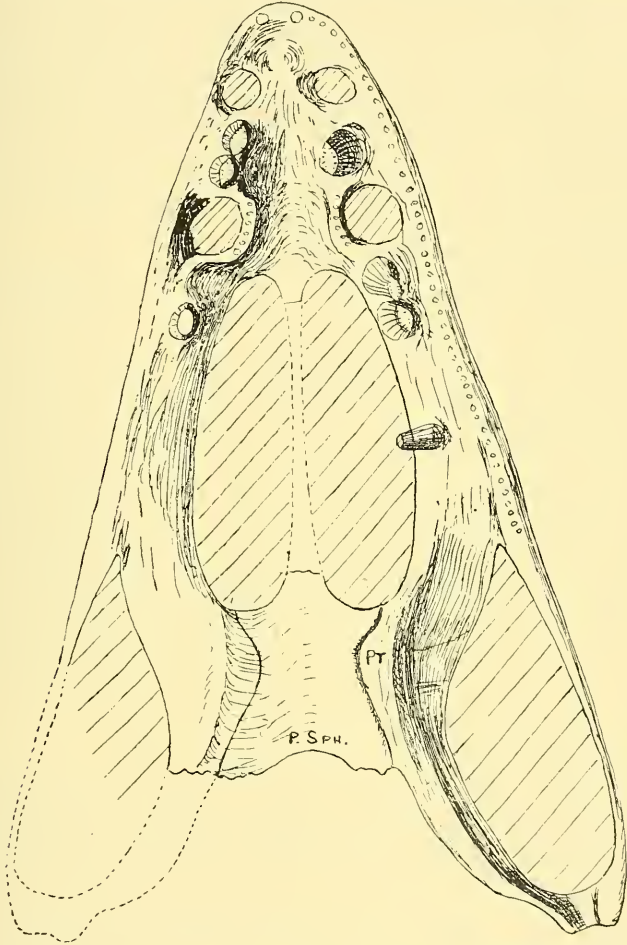
The processus cultriformis of the parasphenoid is long and narrow, broadening posteriorly. As in *Trematosaurus*, the parasphenoid has a free posterior end, where it is a broad, fairly thick plate of bone with a



TEXT-FIG. 17.—*Microposaurus casei*, gen. et sp. nov. Outline of dorsal view of type.

ventral surface which is concave from side to side and convex from back to front. It has an arcuate suture with the pterygoid on each side. Laterally it supports the exoccipital; and—save for the possible presence of a small basioccipital lying on its dorsal surface—it forms the floor of the brain-case.

The exoccipital forms a large rounded condyle. It is not visible in ventral view, but that fact may be due to crushing of the skull. The inner face of the quadrate ramus of the pterygoid is slightly chan-



TEXT-FIG. 18.—*Microposaurus casei*, gen. et sp. nov. Palatal view of type.

nelled; and between it and the exoccipital the large fenestra ovalis runs forward into the brain. The floor of this opening is mostly formed by the pterygoid, as in *Trematosaurus brauni*. The exoccipital is pierced above this fossa—at the place where it turns outwards to form the lateral wing of the bone—by a small foramen opening into a straight canal which leads forwards and inwards.

The quadrate process of the pterygoid is very long, so that the quadrate lies considerably behind the plane of the condyles. There is a fairly large quadrate foramen.

The epipterygoid is a broad plate of bone articulating with the pterygoid in advance of the condylar plane. Owing to the crushing of the skull it is flattened downwards. Its upper end is missing.

The bones of the brain-case have become displaced by shattering, and "stringers" of very hard ferruginous matrix pierce the bones in varying directions. I have not been able to delimit the various bones of the otic region, nor to determine satisfactorily whether or not a basioccipital is present.

The chief measurements are as follows:—

Greatest length	435 mm.
Greatest width	260 ,,
Tip of snout to back of condyles	350 ,,
Snout to plane of front of nostril	40 ,,
Length of nostril	36 ,,
Internasal width	20 ,,
Preorbital length in median line	125 ,,
Interorbital width	82 ,,

Type.—Somewhat crushed skull (S.A.M., Cat. No. 6556).

Locality.—Wonderboom, S. of Burghersdorp, C.P.

Horizon.—Upper Beaufort Beds. *Cynognathus* zone.

Fam. BRACHYOPIDAE, Broom.

1915. Broom, P.Z.S., p. 366.

1919. Watson, Phil. Trans., B, 209, p. 68.

"Stereospondyls with short parabolic skulls, orbits of medium or large size placed anteriorly. Pterygoids turned downwards at the sides so that the palate is trough-shaped." (Watson.)

Gen. BATRACHOSUCHUS, Broom.

1903. Broom, Geol. Mag., N.S., Dec. iv, vol. x, p. 499.

1919. Watson, Phil. Trans., B, 209, p. 44.

Batrachosuchus browni, Broom.

1903. Broom, *loc. cit.*, p. 499.

The type is a beautifully preserved skull lacking the maxillary and premaxillary borders. The sutures of the top of the skull are all

displayed save in the nasal region. The median length of the top of the skull is 200 mm.; the maximum length 250 mm.; and the greatest width 250 mm. The interorbital width is 87 mm.

The chief features of the genus have been noted by Watson. The orbits are wholly in the anterior half of the top of the head, and are widely separated.

The nasals are fairly small, but form the inner and posterior borders of the nostrils. Posteriorly they articulate with the prefrontals, frontals, and with a small median element, the interfrontal. The latter is diamond-shaped and lies between the nasals and frontals. The frontal is excluded from the orbital border. The parietals are larger than the frontals. The suprasquamosals are large; the portions of the tabularia and dermosupra-occipitals occurring on the roof are small.

The palatal and occipital features displayed agree almost entirely with those described by Watson for his *Batrachosuchus* sp. A slight difference exists, however, in that in *B. browni* the parasphenoid does not extend to the back of the skull between the condyles, but stops short of the posterior border, a plate of exoccipital about 10 mm. broad lying between the condyles behind the parasphenoid. The ventral surface of the parasphenoidal plate is sculptured like the top of the skull, but more lightly.

Type.—Skull (S.A.M., Cat. No. 5868).

Locality.—Aliwal North, C.P.

Horizon.—Upper Beaufort Beds. *Cynognathus* zone.

Batrachosuchus sp., Watson.

1919. Watson, *loc. cit.*, p. 44, figs. 27, 28, pl. i.

This skull, now in the British Museum—from an unknown locality,—differs from the type of *B. browni* in having a maximum width greater than the basal length. Further, there is apparently no interfrontal, and the parasphenoid passes further back. It certainly seems to indicate another species, and the suggestion is made that the form be known as *Batrachosuchus watsoni*, sp. nov.

GRADE INCERT ?.

Gen. PHRYNOSUCHUS, Broom.

1913. Broom, *Ann. S. Afr. Mus.*, vol. xii, pt. 1, p. 6.

Phrynosuchus whaitsi, Broom.

1913. Broom, *loc. cit.*, text-fig. 1.

Original description : " The specimen consists of much of the skull in a very weathered condition, remains of most of the vertebrae and short ribs as far as the pelvic region, the most of the right front and hind limbs, and considerable indications of the dermal covering. Allowing for a moderate tail, the whole animal measured about 350 mm.

" The skull shows the impressions of most of the bones of the cranium, and is so broken across as to reveal the structure of at least the front half of the palate. The whole head is broad and very flat. The nostrils are wide apart, and the orbits, which are also far apart, are entirely in the anterior half of the skull.

" The nasal is probably very large, the prefrontal and lachrymal very small. Each frontal is broad, and shut out from the orbital margin by the meeting of the postfrontal with the prefrontal.

" The postfrontal is large and forms the greater part of the upper orbital margin. The postorbital is much smaller.

" The parietal is a large bone, with a small pineal foramen between the pair of bones. The squamosal is rather smaller than the parietal. Outside of the squamosal is a large quadratojugal.

" Behind the parietal is a large occipital.

" The parasphenoid (or vomer) is of large size and extends far forward as a broad flat plate. The prevomers are large and the internal nares far apart. The palatines are also large.

" The teeth are not well shown but are manifestly labyrinthodont. The length of the skull is about 68 mm., and the width almost exactly the same.

" Behind the occiput are some crushed bones which may be parts of the clavicles and interclavicle, and by the side of the neck are some small ossicles which may be the remains of gill arches.

" The body is long and salamander-like. The vertebrae are very imperfectly ossified and represented by paired ossifications, probably representing pleurocentra. The ribs are short as in the Branchiosauridae and almost straight.

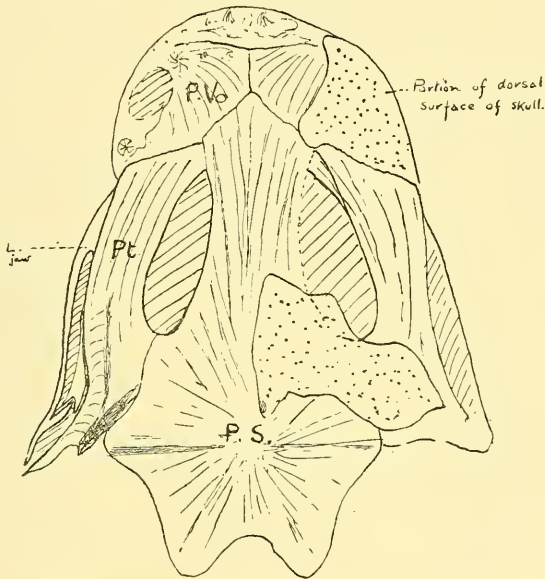
" The shoulder girdle and clavicular apparatus are not well preserved, but the humerus, radius, and ulna of the right side are seen. The humerus is a short bone, with a moderately wide distal end. The length is 16 mm., and the distal end is 9 mm. wide. The radius is a slender rod 10 mm. in length, and the ulna is rather stouter.

“Of the hind limb the only parts preserved are a portion of the tibia, five metatarsals, and two phalanges. There are certainly five digits, and the tarsus is unossified.

“There is a complete exoskeleton of thin, ossified scales.”

Recently I have, without seriously damaging the specimen, exposed the dorsal surface of the palate of the type.

Parasphenoid.—The middle of the palatal side of the skull is occupied by a large bone, the anterior portion of which Broom recog-



TEXT-FIG. 19.—*Phrynosuchus whaitsi*, Broom. Dorsal view of palate of type.

nised as the parasphenoid. The posterior two-thirds of the bone is a pentagonal plate whose posterior edge is excavate and whose hinder lateral edges are slightly concave.

Anteriorly the plate is produced with a broad bar separating the interpterygoid vacuities. This bar expands slightly in front of the vacuities and is bluntly pointed, articulating with and partly separating the prevomers. The anterior lateral edges of the basal portion of the parasphenoid articulate with the pterygoids. The excavate hinder portion of the bones figured by Broom as “dermo-occipitals” is really part of the parasphenoid.

Pterygoid.—From its articulation with the parasphenoid the pterygoid sends forward a long broad curving flattened plate as an

anterior ramus, and a shorter, more slender, vertically placed posterior ramus. The former bounds the interpterygoid vacuity on its outer side and articulates in front with the prevomer; the latter passes back, presumably to the quadrate, and reaches the top of the skull.

The interpterygoid vacuities are fairly small and much longer than wide.

Prevomer.—The prevomers occupy most of the short wide section of the palate in front of the interpterygoid vacuities. They articulate posteriorly with the pterygoids and medially with each other and with the parasphenoid which overlaps on to them dorsally.

The internal nasal openings are wide apart, and their inner borders are formed by the prevomers. The prevomer carries a large tusk in front of the inner border of the internal naris.

No separate palatine can be distinguished in dorsal view. In *Nyrania*, which this form somewhat resembles, the palatine is figured as lying along the inner border of the interpterygoid vacuity; there is no evidence to show that it occupied that position in *Phrynosuchus*. The bone identified by Broom as "palatine" is presumably a part of the anterior ramus of the pterygoid.

The premaxilla lies in front of the prevomer and carries small teeth on its border.

It is probable that on the dorsal surface of the skull there was a small tabular projection on the posterior border.

The lower jaw is slender, and the dentary carries a row of pointed labyrinthodont teeth.

Type.—Incomplete skull and skeleton (S.A.M. Cat. No. 2357).

Locality.—Droogvoets, Fraserburg, C.P.

Horizon.—Lower Beaufort Beds. ? *Endothiodon* zone.

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